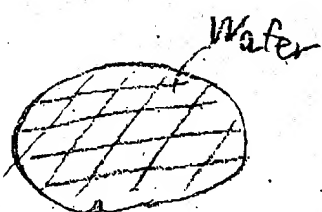


Process flow of Flip Chip interconnection.

Fig. 1A



Cross Section of electrode pad.

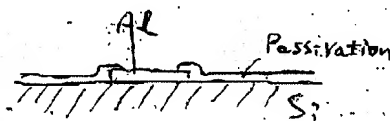


Fig. 1B UBM forming
(Under Bump Metals)

UBM is formed by
sputtering or plating.

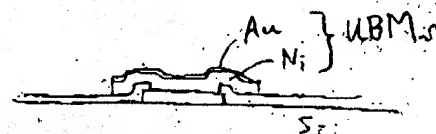


Fig. 1C Solder Bump forming

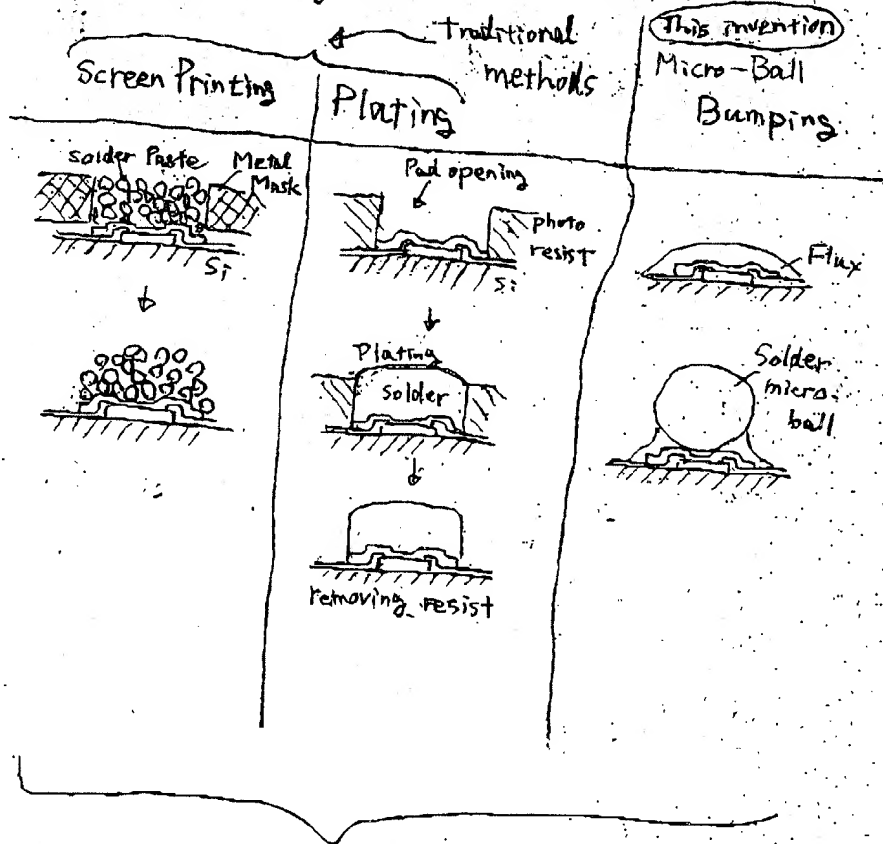
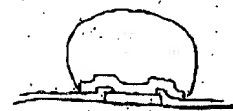


Fig. 1D Reflow



Complete

Fig. 1E Dicing

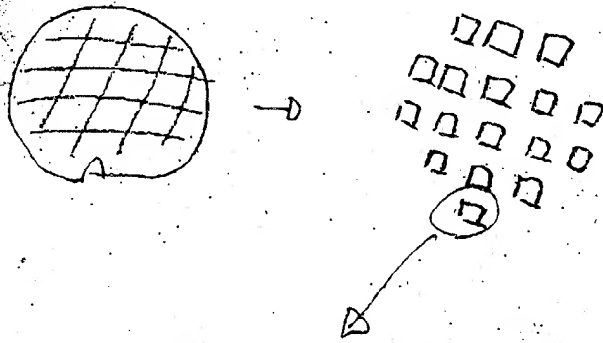


Fig. 1F Flip Chip Bonding

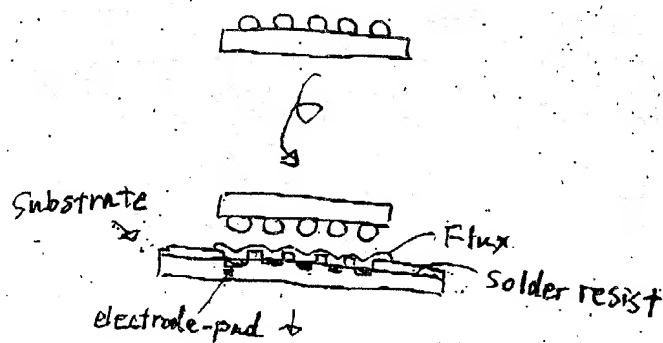


Fig. 1G Reflow and cleaning

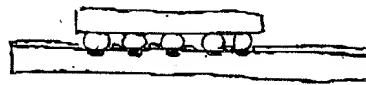
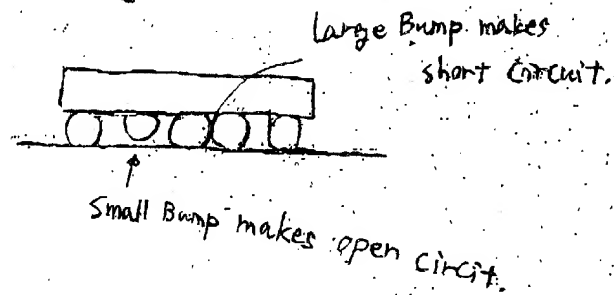
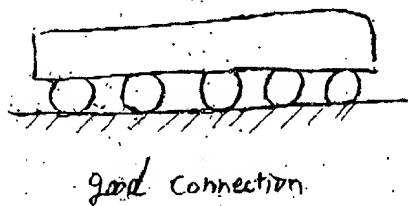


Fig. 1H

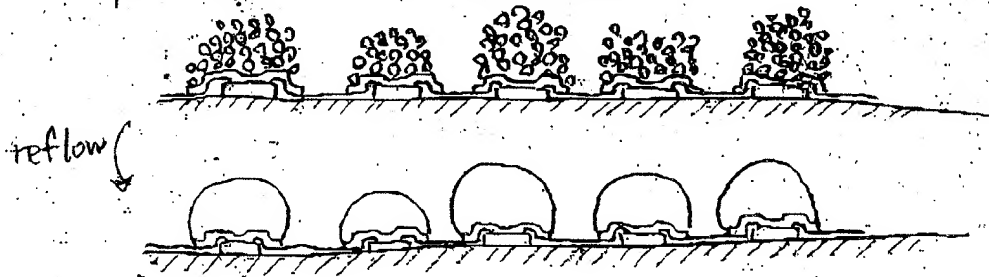


Appendix I

Screen printing

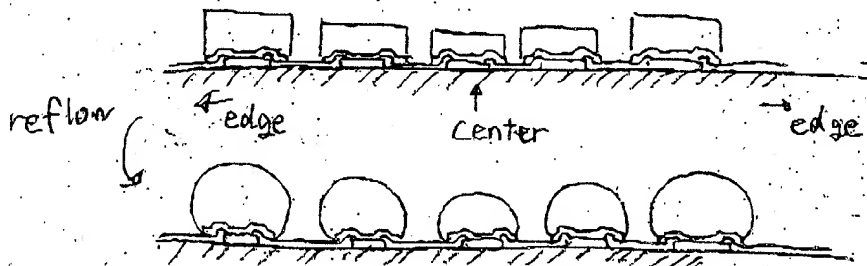
amount volume has variation.

The amounts of paste remaining on electrodes when a mask for printing is removed are varied.



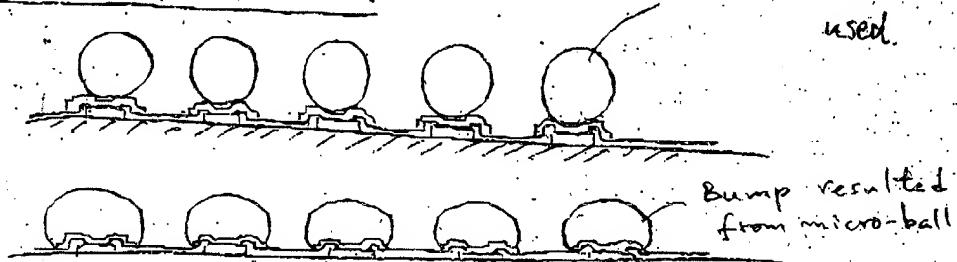
Plating

There is difference in current density during plating at the center and the edge of wafer, and the thicknesses of plated material are varied accordingly.



Micro-Ball (this invention)





High accuracy
micro-balls are
used.



Micro-balls are made with high accuracy, and bumps are not varied.

Appendix II

COMPARISON OF BUMPING TECHNOLOGIES

	ADVANTAGES	DISADVANTAGES
EVAPORATION 	<ul style="list-style-type: none"> • Proven Technology 	<ul style="list-style-type: none"> • Complex process • High material waste • Alloy control difficult • Expensive process
PLATING 	<ul style="list-style-type: none"> • Proven Technology • Fine Pitch 	<ul style="list-style-type: none"> • Several process steps • Alloy control difficult • Environmental issues
SCREEN PRINTING 	<ul style="list-style-type: none"> • High Throughput • Solder paste process 	<ul style="list-style-type: none"> • Not capable of fine pitch • Bump height distribution
MICRO-BALL 	<ul style="list-style-type: none"> • High Throughput • Uniform bump height • Flexible alloy selection 	<ul style="list-style-type: none"> • New Technology

There is a variation in the amount of plated solder between raster center to edge.

There is a variation in the amount of printed paste.

Balls with high accuracy is used.

Appendix III

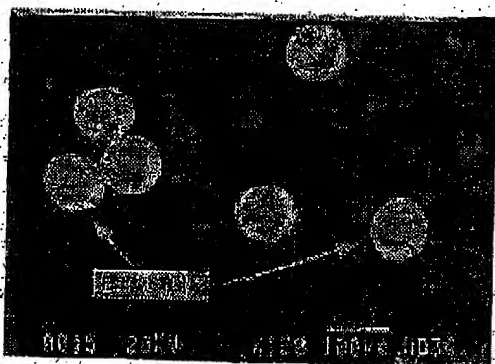


Figure 8. An example of irregular sphericity ball.

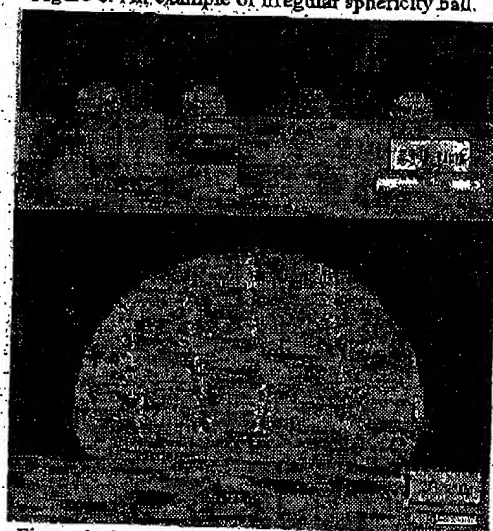
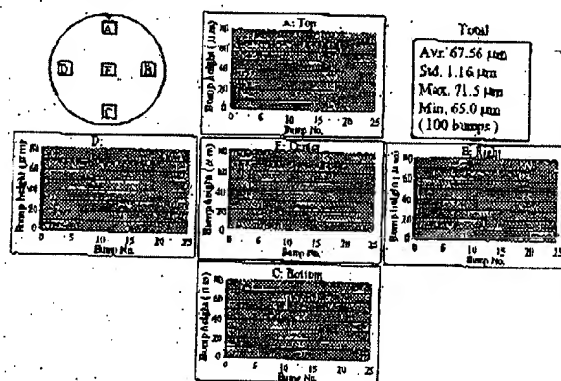
Figure 9. Cross sections of solder bumps formed using solder balls of 100 μm in diameter on Ni / Au UBMs by electroless plating.

Figure 10. Height variation of micro-ball bumps in an 8 inch wafer.

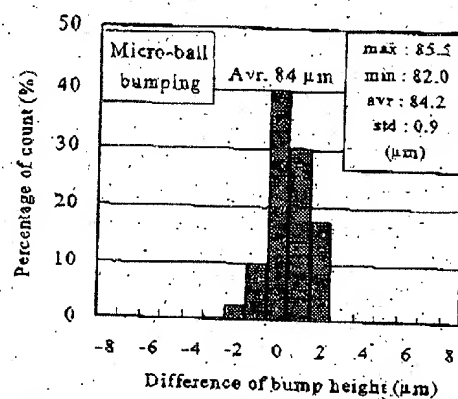


Figure 12a. Height variation of micro-ball bump (bumps formed by micro-ball bumping).

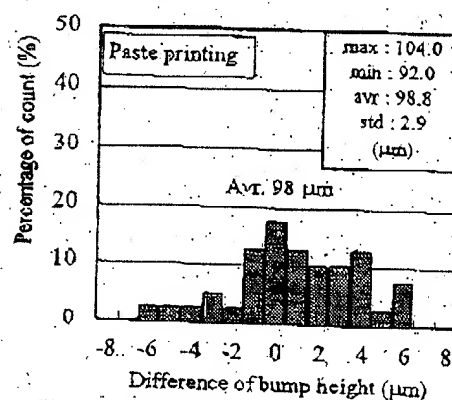


Figure 12b. Height variation of paste printing (bumps formed by printing paste).

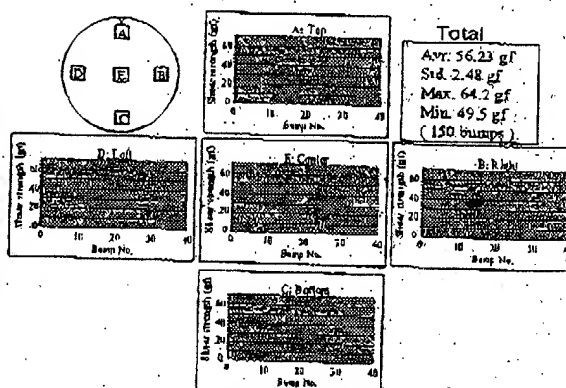


Figure 11. Shear strength variation of micro-ball bumps in an 8 inch wafer.